Department of Mathematics

Forecasting Starbucks Corporation Revenue

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Abstract:

This project uses data from Starbucks Corporation worldwide financial report from 1985 to 2016 to forecast the revenue for the next seven quarters (two years). To do this, we analyze the quarterly revenue of the company over the past thirty years and use different time series analyses techniques to build a series model to be used to forecast future revenue time.

Model development:

To study the data for Starbucks revenue, we need to use a time Series ARIMA model. Noting that an ARIMA model apply the criteria of regression model on the Time series data since regression model can't do that.

Process for Building an ARIMA Model:

Step 1: Pre-differencing.
Transformation variables for constant seasonal variation.
Data did not need pre-differencing.

Step 2: Differencing.
The data must also be stationary (constant mean and constant variance). By using the 1st order differencing with 1st order seasonal differencing the data became stationary.

Step 3: Identify the model (pre intervention).
Use Sample Auto-Correlation (SAC) and Sample Partial Auto-Correlation (SPAC) graphs provided by SAS and other factors to find the best model.

Step 4: Run Diagnostic Checks on the Model.
Test the estimating parameters to ensure their significance.

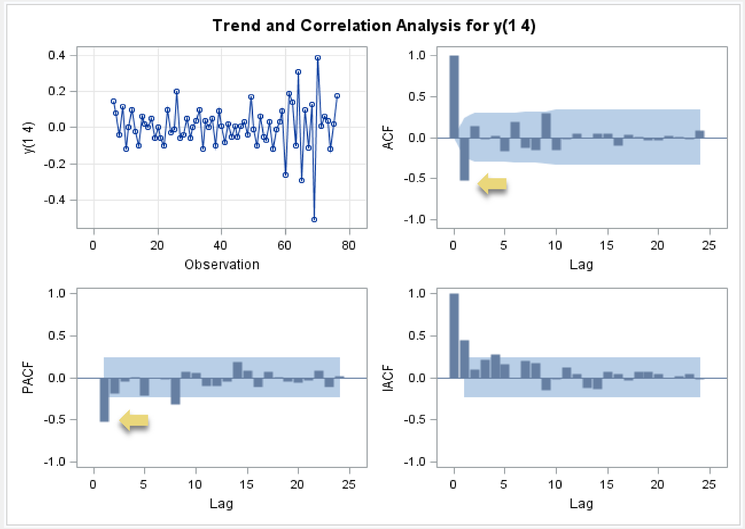
Step 5: Use the Model to Forecast.
Use the model to forecast future values, find confidence intervals for future values, and test the model against known values to establish goodness of fit.

ARIMA Model Development

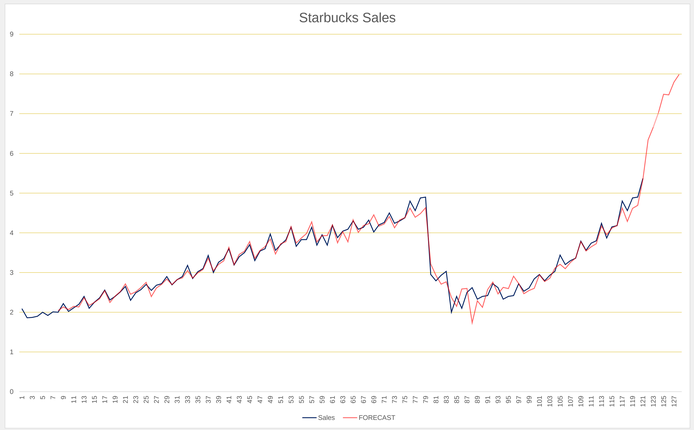
- The site Y charts provided Quarterly revenue for Starbucks corporation world wide from 1985-2016.
- Before building an ARIMA model, tested a Regression Model and the model was not significant.

Model Development:

- **Step 1: Pre-Differencing.**
- **No pre-differencing is needed.**
- **Step 2: Differencing.**
- **1st Order Seasonal Differencing w/L=4 with 1st order Differencing.**
- **Step 3: Identify The Model.**
- **The best model is MA(1).**
- **Step 4: Run Diagnostic Checks on the Model.**
- **θ_1 is significant, intercept is not significant.**
- **Step 5: Use the Model to Forecast.**



Forecast Model



Forecasts for variable y				
Obs	Forecast	Std Error	95% Confidence Limits	
122	6.3415	0.9168	4.5447	8.1383
123	6.6615	0.9173	4.8637	8.4593
124	7.0200	0.9505	5.1569	8.8830
125	7.4900	0.9510	5.6260	9.3539
126	7.4744	0.9888	5.5365	9.4124
127	7.7944	0.9906	5.8528	9.7361
128	7.9883	1.0006	6.0272	9.9494

Forecast Model Formula

General ARIMA Model w/Differencing

$$(1-\varphi_1 B \ldots-\varphi_p B^p-\varphi_{1,L}B^L \ldots-\varphi_{P,L}B^{P*L})Z_t = \delta+(1-\theta_1 B \ldots-\theta_q B^q-\theta_{1,L}B^L \ldots-\theta_{Q,L}B^{Q*L})a_t$$

Model for MA(1) w/1st Order Seasonal Diff., L=4

$$Z_t=\frac{C\,(1-w_2 B^2)}{(1-\delta_2 B^2)}Z_t(P_t)+\varepsilon_t\,,\quad Where,\quad \varepsilon_t=\frac{a_t}{(1-\theta_1 B)}$$

$$(y_t-y_{t-1}-y_{t-4}+y_{t-5})=\frac{C\,(1-wB^2)}{(1-\delta B^2)}(P_t-P_{t-1}-P_{t-4}+P_{t-5})+\varepsilon_t$$

$$Where,\ \varepsilon_t=\frac{a_t}{(1-\theta_1 B)}\quad and\quad \widehat{\theta_1}=0.82597\,,\ C=-1.88282\,,\ w=-0.82993\,,\ \delta=0.71578$$

Conclusion

- The ARIMA model fit was satisfactory, but the standard error of the forecasts are larger than desired.
- We could add another explanatory variable such as temperature to build a more in-depth model.